Upscaling of Forested Landscapes in the Great Lakes Region

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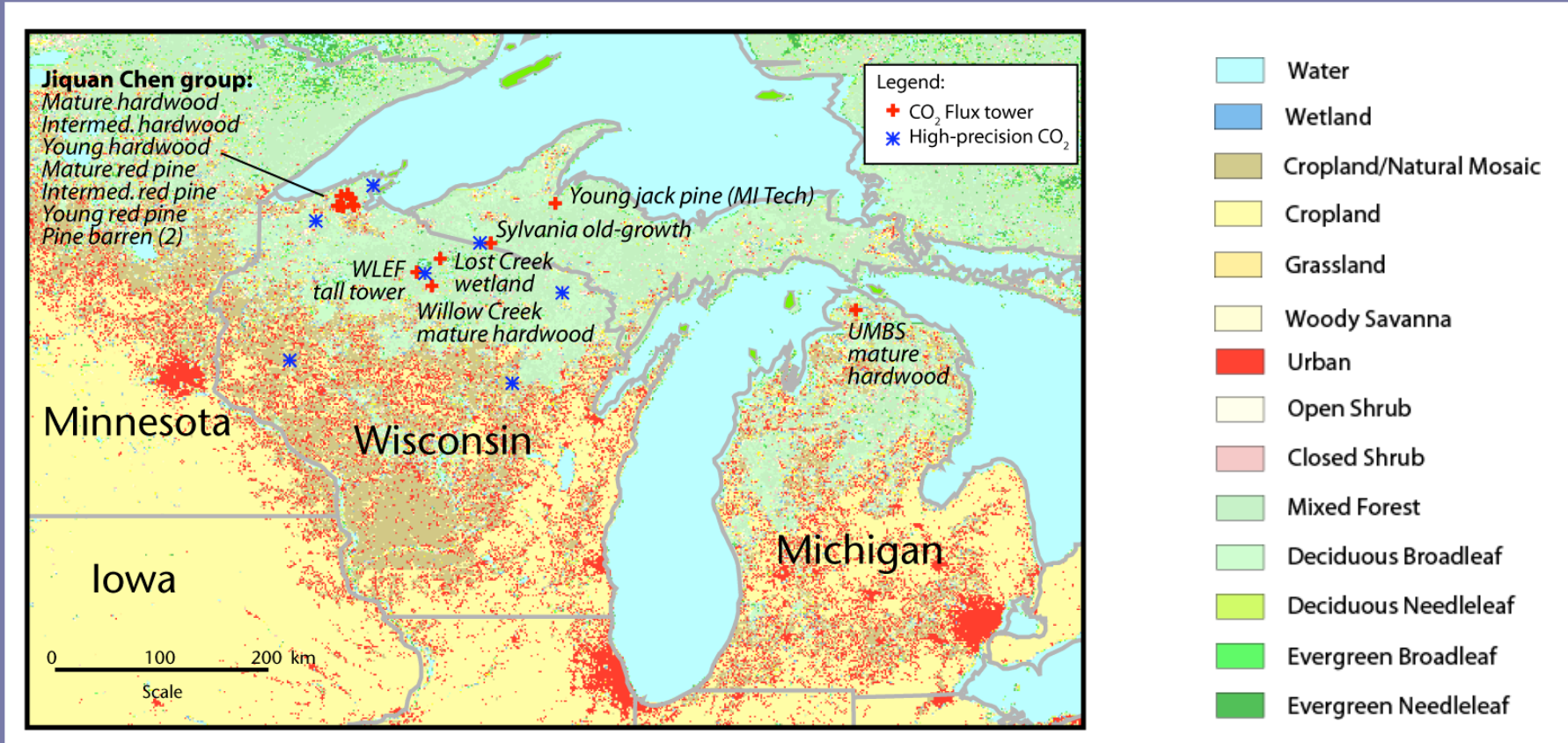
Stand

Landscape

Region

ChEAS (Chequamegon Ecosystem-Atmosphere Study)

- Initiated by the WLEF flux/mixing ratio observatory (1995)
  – 400m tower

- Forest-domain regional flux experiment

  – Complementary investigations started ~1997

  – no centralized support – DOE, NASA, USDA-FS, NOAA, NSF projects.

- Multiple atmospheric budget and upscaling efforts already published/in press.

  – See pubs at http://cheas.psu.edu

ChEAS Measurements

- 400 m 'tall tower' with F_{CO_2}, $[CO_2]$
- Stand-scale flux tower network
- Regional $[CO_2]$ tower network
- Airborne $[CO_2]$ profiles
- Column $[CO_2]$ by FTIR
- ABL Profiling with radar and ceilometer
- Airborne and satellite remote sensing
- Chamber and sap flux measurements
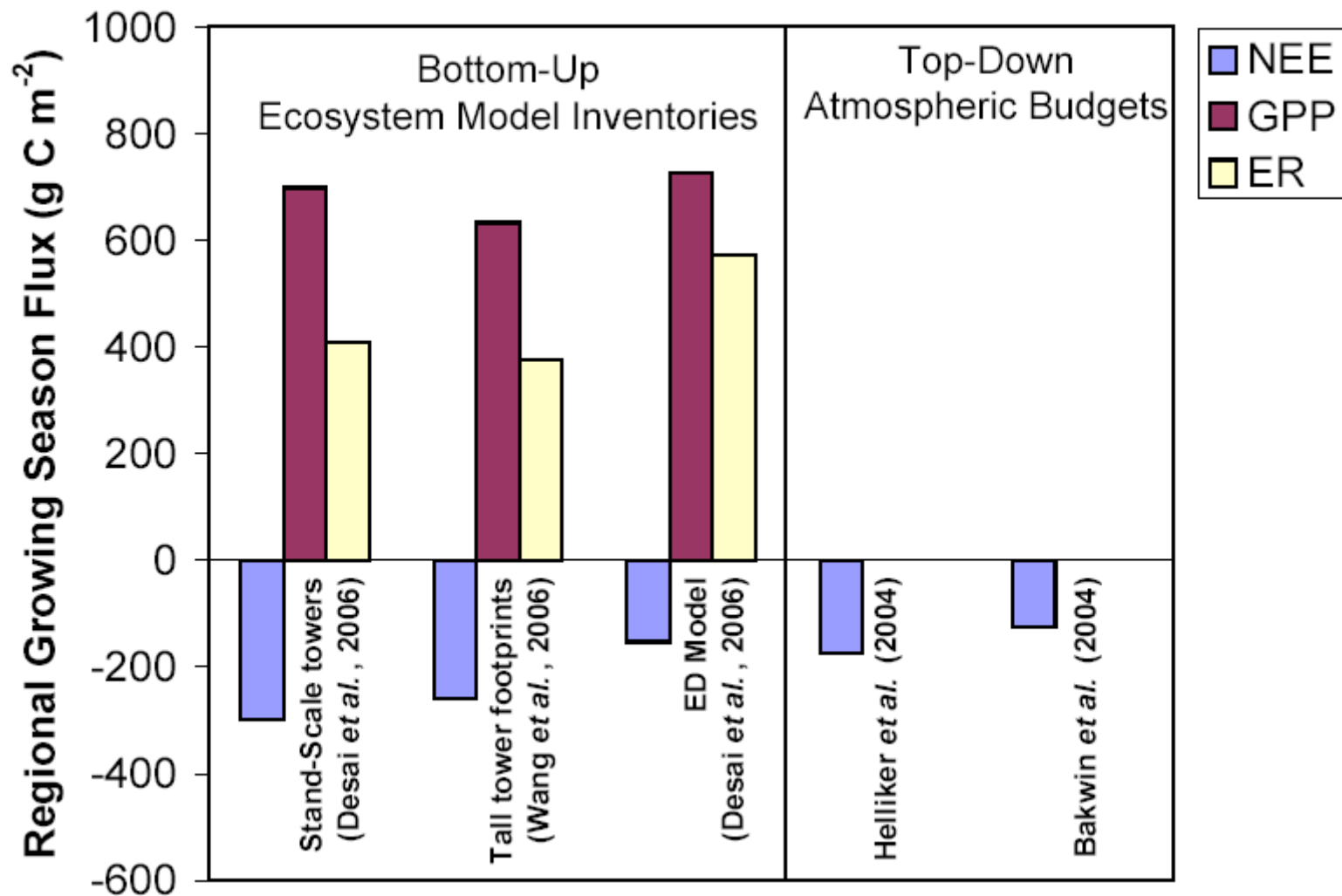- Biometric measurements

Regional Scaling with Simultaneous Constraints
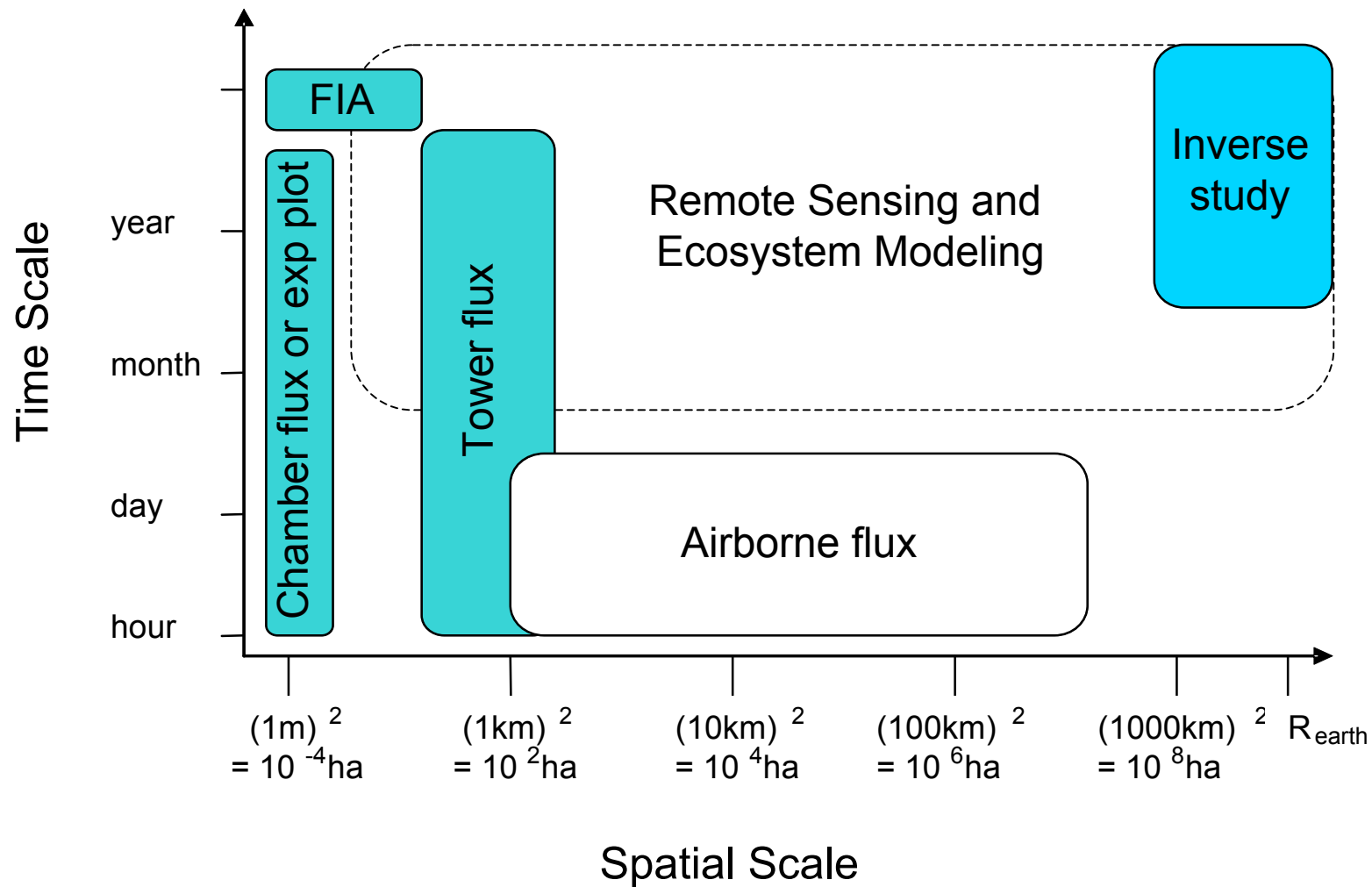
Results to date

- Regional flux aggregations studies

    - Tall tower flux footprint decomposition (Wang)

    - Stand-level flux tower aggregation (Desai)

- Atmospheric budgets

    - Traditional hourly ABL budget (Wang)

    - ABL-FT 'synoptic cuvette' (Helliker, Bakwin)

Preliminary Comparisons

ChEAS/NACP Experimental Design

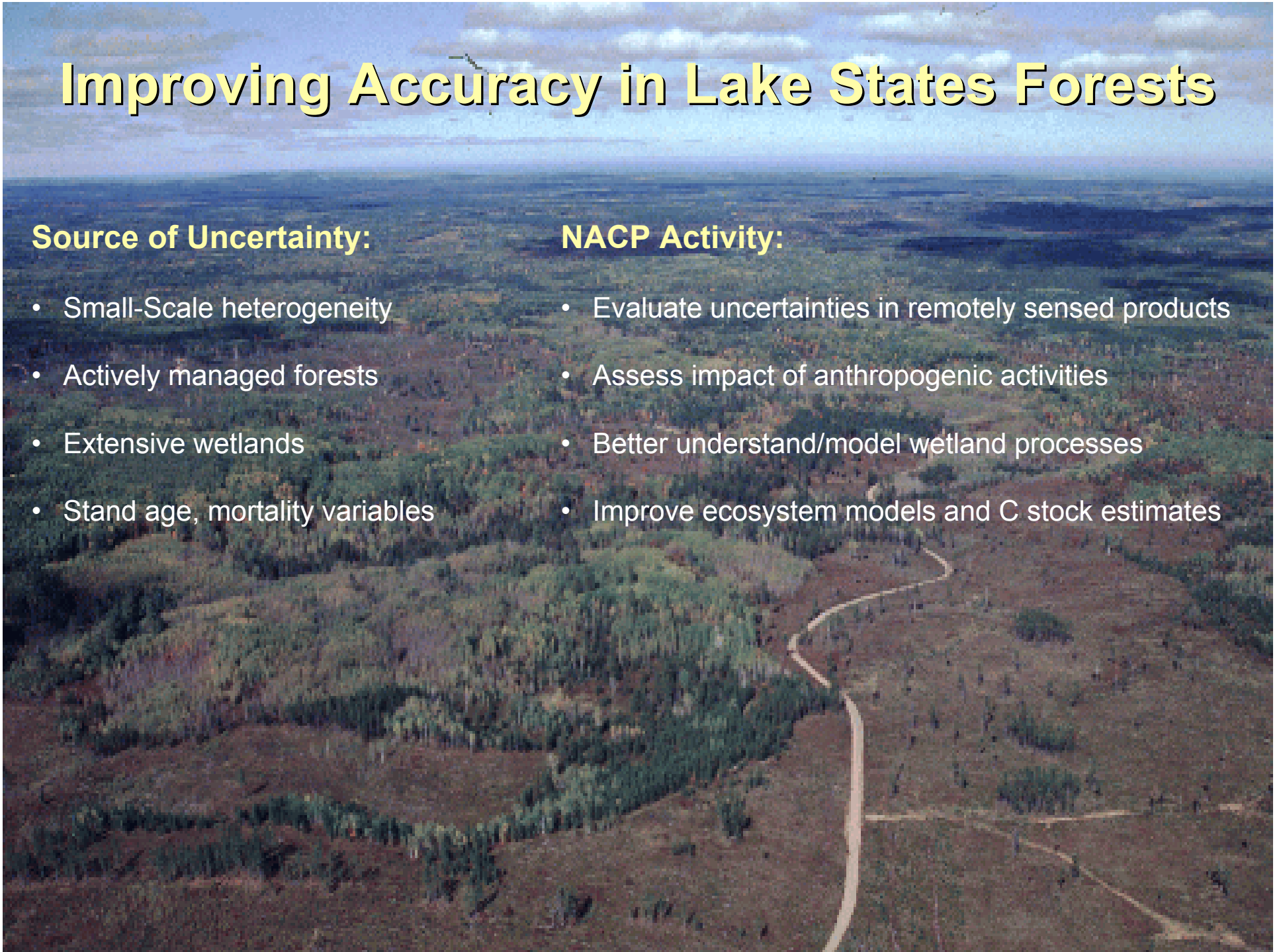| Tier	Sampling	Methods
1	Wall-to-Wall	*Remote sensing imagery*: • Airborne LiDAR • High- to moderate-resolution • Multi- and hyperspectral imagery *Ecosystem models:* • MODIS GPP/NPP algorithm • BIOME-BGC (incl. wetland modification)
2	Extensive	• Forest Inventory and Analysis (FIA)
3	Extensive-Intensive link	• Spatiotemporal measurements of vegetation, soils, carbon stocks • Chamber fluxes
4	Intensive	• Flux towers (stationary and mobile) • Tier 3 measurements

Improving Accuracy in Lake States Forests

Source of Uncertainty:

- Small-Scale heterogeneity

- Actively managed forests

- Extensive wetlands

- Stand age, mortality variables

NACP Activity:

- Evaluate uncertainties in remotely sensed products

- Assess impact of anthropogenic activities

- Better understand/model wetland processes

- Improve ecosystem models and C stock estimates

MCI Needs and Gaps

Activity	Need
Remote Sensing and Ecosystem Modeling	• High resolution climate data (5-10 km) • Hydrologic data (e.g., local water table heights)
Intensive Sampling	• Methane flux measurements
Extensive Sampling	• Forage and grasslands are under-represented

Collaboration	• Coordinate activities
	   – Leverage resources (e.g., remote sensing platforms)
	   – Avoid duplication of efforts
	• Integrate ecosystem modeling efforts (workshops?)
	• Top-Down comparisons and synthesis

Additional Concerns, Opportunities

Concerns:

– Flux tower support uncertain past 2005/6

– Little focus on methane – important regional flux

– Ecological models, land classification and upscaling data may not be up to the task (e.g. wetlands)

Opportunities:

– Data-rich site!

– Collaborators welcome (inverse modeling, ecosystem modeling, additional upscaling observations, trace gas measurements, …).